

Claims

1. A solid-state laser, the laser material (1) of which is pumped with the aid of at least one pump light source (5), e.g. one or more laser diode arrays at least approximately perpendicularly to the axis of a laser beam substantially absorbed in the laser material (1), the pump beams being imaged or focussed in said material with the aid of focussing optical elements, e.g. cylindrical lenses (6), characterized in that opposite the entry surface area at least one interface is provided in said material (1) configured such that said pump beams are reflected by said interface to again pass through said laser material and/or an external reflector is provided following said opposite interface for reflecting said pump beams back into said material.
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 2. The solid-state laser as set forth in claim 1, characterized in that reflectors (7) e.g. cylindrical mirrors are provided which direct said pump beam after it having passed through and left said material for a second time, back into said material for a further time.
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 3. The solid-state laser as set forth in claim 2, characterized in that the images of said pump beams created with the aid of said optical elements (6) and with the aid of said reflectors (7) overlap partly or fully.
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 4. The solid-state laser as set forth in any of the preceding claims, characterized in that the reflectance of said interface of said material (1) opposite said entry surface area is enhanced with the aid of a corresponding coating and/or by having suitably selected the angle of incidence.
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 5. The solid-state laser as set forth in any of the preceding claims, characterized in that the emitting surface areas of said pump light sources are significantly longer in one direction than in the other, or that a train of small emitting surface areas is arranged along the preferred direction.
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6. The solid-state laser as set forth in any of the preceding claims, characterized in that said surface area through which said pump beams enter into said laser gain material (1) and/or said opposite interface are flat.
- 5 7. The solid-state laser as set forth in any of the preceding claims, characterized in that said laser beam (8) is formed at least roughly parallel between the side interfaces of said material (1).
8. The solid-state laser as set forth in any of the claims 2 to 7, characterized in that
10 provided between said laser material (1) and said mirrors (7) are optical elements (11), e.g. lambda quarter plates which are passed through by said pump beams in the path to said mirrors (7) and back, and that with the aid of these elements the polarization direction of said beams on this path is rotated preferably through 90° in all.
- 15 9. The solid-state laser as set forth in claim 8, characterized in that in the path of said pump beams between said pump light sources (5) and lambda quarter plates (11) optical elements (9), e.g. polarization beam splitters are provided with the aid of which the paths of said beams coming from said pump light sources, on
20 the one hand, and said beams whose polarization plane has been rotated through 90° by said optical elements are separated three-dimensionally, on the other, and that the latter are imaged in turn in said laser material (1) with the aid of reflectors (12), e.g. cylindrical mirrors.
- 25 10. The solid-state laser as set forth in claim 9, characterized in that said polarization beam splitters are configured as Foster prisms.
11. The solid-state laser as set forth in any of the preceding claims, characterized in that said cylindrical lenses (6) imaging said pump light sources in said laser material are configured as lens systems (13) for reducing spherical aberration.
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12. The solid-state laser as set forth in any of the preceding claims, characterized in that provided at a small distance before said laser material (1) is a cylindrical di-

vergent lens (14) having the purpose of reducing the angle of incidence of said pump beams on said slab.

- 5 13. The solid-state laser as set forth in any of the preceding claims, characterized in that a plurality of pump light sources is arranged perpendicularly to their linear extent juxtaposed laterally and that their beams impinge said laser material (1) at diverse angles.
- 10 14. The solid-state laser as set forth in claim 13, characterized in that said images of said pump light sources do not precisely overlap in said laser material, they instead being slightly displaced laterally perpendicular to their linear extent for the purpose of the transverse pump profile resulting from the overlap of said pump beams being similar to a box profile.
- 15 15. The solid-state laser as set forth in any of the preceding claims, characterized in that parallel to their linear extent a plurality of pump light sources is arranged inline single or in groups for the purpose of pumping a stripe region whose length is a multiple of the length of said individual pump light sources, said region also possibly being composed of portions.
- 20 16. The solid-state laser as set forth in any of the preceding claims, characterized in that at least one surface, preferably opposite surfaces of said laser material (1) are cooled with the aid of a fluid medium.
- 25 17. The solid-state laser as set forth in claim 16, characterized in that the temperature of said coolant is diverse on opposite sides of said laser material, e.g. by said medium serving to cool one of said two sides being heated for the purpose of compensating any lack of symmetry in the temperature distribution in said laser material (1).
- 30 18. The solid-state laser as set forth in claim 16 or 17, characterized in that said cross-sections of the flow channels on both sides of said laser material (1) are dimensioned diversely to differinglly cool said laser slab at its upper and lower side.

19. The solid-state laser as set forth in any of the preceding claims, characterized in that said laser material (1) is cooled with the aid of heat sinks consisting of solid-state material of high thermal conductivity which leave a gap free through which said pump beam can enter into said laser material.
20. The solid-state laser as set forth in claim 19, characterized in that heat sinks cooled to diverse temperatures are provided for the purpose of compensating any lack of symmetry in the temperature distribution in said laser material (1).
21. The solid-state laser as set forth in any of the preceding claims, characterized in that said laser material (1) is pumped from several sides by the light from said pump light sources (5) being imaged with the aid of optical elements e.g. cylindrical lenses (6) from one or more sides into a rod-shaped laser material (1) and after having been reflected at the opposite interface, passes through said material once again.
22. The solid-state laser as set forth in claim 21, characterized in that some or all of said technical elements defined in the preceding claims for imaging, redirecting, reflecting or polarizing said pump beams also find application for said beams coming from the other side(s).
23. The solid-state laser as set forth in claim 21 or 22, characterized in that said laser material (1) is surrounded at said sides by a case (18) which is transparent for said pump radiation and that a coolant (4) flows in the interspaces between laser material and case.
24. The solid-state laser as set forth in any of the preceding claims, characterized in that the end faces of said laser material (1) are ground flat and mirror-finished perpendicular to the linear extent of said pumped region in thus serving as end mirrors for a laser resonator.

25. The solid-state laser as set forth in any of the claims 1 to 23, characterized in that external end mirrors (15) separate from said laser material (1) are used to form a laser resonator.
- 5 26. The solid-state laser as set forth in any of the preceding claims, characterized in that said pumped regions are arranged in a zig-zag formation between diversion mirrors so that a folded beam path materializes.
- 10 27. The solid-state laser as set forth in any of the claims 1 to 23 or 26, characterized in that to avoid resonator end mirrors, use is made of the inversion built up in said laser material (1) to amplify a laser beam coupled into said slab from the outside.
- 15 28. The solid-state laser as set forth in any of the preceding claims, characterized in that one or more surfaces of said laser material (1) are coated antireflecting for possible laser wavelengths.
- 20 29. The solid-state laser as set forth in any of the preceding claims, characterized in that some of said opposite side surface areas of said laser material (1) are slightly inclined to each other.
- 30 30. The solid-state laser as set forth in any of the preceding claims, characterized in that one or more side surface areas of said laser material are roughened.
- 25 31. The solid-state laser as set forth in claim 2 or any of the claims 4 to 30, characterized in that images of said pump beams generated with the aid of optical elements (6) and with the aid of reflectors (7) or (21) in said laser material (1) are located juxtaposed and that said pump beam, after having passed through said second region, is directed back with the aid of diversion mirrors into said first region in again passing therethrough.
- 30 32. The solid-state laser as set forth in claim 31, characterized in that said pump beam after having passed through said second region is directed by diversion mirrors into a third adjacent region, and so on, to then be directed from said last

region passed through in the reverse sequence through said regions as passed through prior.

- 5 33. The solid-state laser as set forth in claim 31 or 32, characterized in that further pump beams pass through one or more regions pumped by said first beam, but in a different sequence.
- 10 34. The solid-state laser as set forth in claim 31, 32 or 33, characterized in that said laser beam is directed with the aid of diversion mirrors through said pumped regions in sequence.
- 15 35. The solid-state laser as set forth in any of the claims 1 to 34, characterized in that said laser material (1) is doped only in partial regions.
36. The solid-state laser as set forth in claim 35, characterized in that said laser material is a slab comprising three layers, of which the middle (25) is doped whilst the upper and lower layers (24) are not doped.